

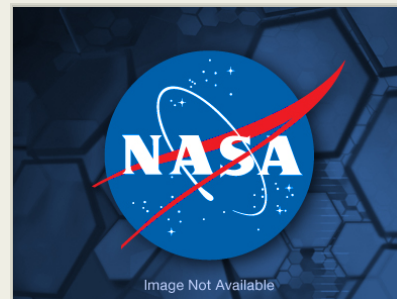
# Faint Intergalactic Redshifted Emission Balloon (FIREBALL)-2: Flight Test of Next Generation UV Detector and Spectrograph (Co-I Proposal)

Completed Technology Project (2015 - 2016)



## Project Introduction

Columbia University is a Co-I institution in a collaborative research program with Caltech, the Lead Institution (PI: Christopher Martin). We have developed and successfully flown a path-finding experiment, the Faint Intergalactic-medium Redshifted Emission Balloon (FIREBALL), designed to discover and map faint emission from the Intergalactic Medium (IGM). Our successful science flight in June 2009, proved every aspect of the complex instrument performance, and provided the strongest measurements and constraints on IGM emission available from any instrument. We are preparing a significantly upgraded experiment, FIREBALL-2, for launch in Fall 2015 at Ft. Sumner, New Mexico. We have made progress in spectrograph, detector, and payload design and development. CNES is providing the spectrograph, gondola, and gondola flight support team. Because of a CNES balloon mishap and funding constraints, support for a FIREBALL launch was delayed from Fall 2013 to Fall 2015. We propose 18 months of bridge funding to support the FIREBALL team that includes one woman Ph.D. student at Columbia University. FIREBALL directly supports NASA Science Plan Objectives to "Understand the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today." FIREBALL directly addresses four Core Science Questions from the Astrophysics 2010 Decadal Survey (New Worlds New Horizons). FIREBALL provides flight and science testing of new UV technologies directly called out by NWNH as high priority for the next decade as a precursor to a 4-m class UV/optical future mission. STATUS COMPARED TO 2011 PROPOSAL GOALS. Our proposal in 2011 proposed a relatively simple modification to the FIREBALL-1 payload, replacement of the fiber integral field unit with a multi-bundle fiber interface, and replacement of the GALEX spare NUV detector with a Gen-2, high quantum efficiency UV photon-counting CCD. The modest scale of these changes allowed us to propose a Spring 2013 launch. The accepted proposal and delayed funding profile led to a slip in the launch of one year to Spring 2014. Further evaluation of the science requirements for the spectrograph, observational progress by our group at higher redshift, and strategic development of future multiplexed UV spectrometers led us to significantly redesign the FIREBALL-2 payload. We are implementing a multi-slit spectrograph optimized for detecting circum-galactic medium emission around galaxies at a red-shift near 0.7 (using Ly $\alpha$ ), 0.36 (using CIV), 1.0 (using OVI), or 0.28 (using HeII 1640Å). At the same time the CNES balloon group had a flight mishap that along with budget constraints, along with a decision by CSBF to only support Fall turn-around flights, has delayed the launch from Spring 2014 to a Fall 2015 from Ft. Sumner. We have made significant progress in the payload design and development and on the Gen-2 detector. Key features of the new design include higher angular resolution (improved from 10 arcsec to 5 arcsec) in order to separate galaxy from CGM emission more definitively; a field corrector to provide high resolution images over a 30 arcmin field; a new multi-mask multislit unit with slit masks selectable during



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## Organizational Responsibility

### Responsible Mission Directorate:

Science Mission Directorate (SMD)

### Responsible Program:

Astrophysics Research and Analysis

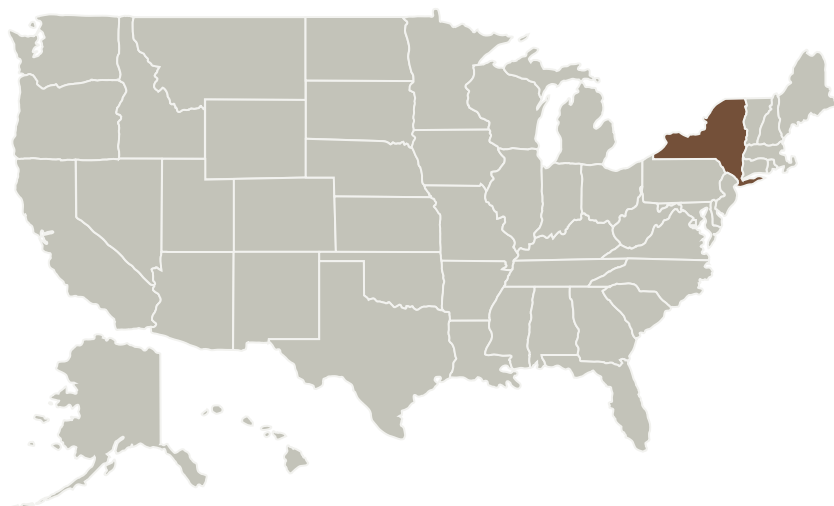
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flight; a fast, wide field Schmidt spectrograph; a windowless spectrograph/detector design which minimizes Cerenkov background; a flight detector cryocooler that will be a pathfinder for satellite detector cooling systems; spectrograph field rotation compensation; a new gondola pointing system that will provide significantly improved pointing control (from 6 arcsec to 2 arcsec). This proposal provides 18 months of additional funding to complete payload integration, support field operations for a single flight, and provide 9 months of post-flight support for data analysis and science publication.

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Columbia University in the City of New York	Supporting Organization	Academia	New York, New York

## Primary U.S. Work Locations

New York

## Project Management

### Program Director:

Michael A Garcia

### Program Manager:

Dominic J Benford

### Principal Investigator:

David Schiminovich

### Co-Investigators:

Heather Horgan

Lauren N Corlies

## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

## Target Destination

Outside the Solar System